

WHAT IS CLAIMED IS:

1 1. An apparatus for forming a material on a semiconductor wafer, the
2 apparatus comprising:
3 a processing chamber defined by walls;
4 a wafer support positioned within the processing chamber and configured to
5 receive a semiconductor wafer;
6 a processing gas supply; and
7 a gas distribution showerhead overlying and separated from the wafer support,
8 the gas distribution showerhead comprising a face plate having an inlet portion comprising a
9 hole in fluid communication with an elongated slot of an outlet portion of the face plate.

1 2. The apparatus of claim 1 wherein a length of the elongated slot is at
2 least one-half a thickness of the face plate.

1 3. The apparatus of claim 1 wherein the gas distribution showerhead
2 further comprises a blocker plate including a perforation, the blocker plate positioned
3 upstream of, and in fluid communication with, the inlet portion of the face plate.

1 4. The apparatus of claim 1 wherein the elongated slots are continuous
2 and oriented concentrically.

1 5. The apparatus of claim 1 wherein a cross-sectional width of the
2 elongated slot is larger than a cross-sectional width of the hole.

1 6. The apparatus of claim 5 wherein the cross-sectional width of the
2 elongated slot is at least 2.25x larger than the cross-sectional width of the hole.

1 7. A gas distribution face plate comprising:
2 a face plate body having a thickness;
3 an inlet portion configured to receive a flow of a processing gas, the inlet
4 portion comprising an aperture having a width;
5 an outlet portion configured to convey the processing gas flow to a
6 semiconductor wafer, the outlet portion comprising an elongated slot in fluid communication
7 with the aperture.

8. The gas distribution face plate of claim 7, wherein the elongated slot has a length at least one-half the thickness of the face plate body.

9. The gas distribution face plate of claim 7 wherein the elongated slot is circular and continuous.

10. The gas distribution face plate of claim 7 wherein a width of the elongated slot is greater than the width of the aperture.

11. The gas distribution face plate of claim 10 wherein the width of the elongated slot is at least 2.25x larger than the width of the aperture.

12. An apparatus for forming a material on a semiconductor wafer, the apparatus comprising:

- a processing chamber defined by walls;
- a wafer support positioned within the processing chamber and configured to receive a semiconductor wafer;
- a processing gas supply; and
- a gas distribution showerhead overlying the wafer support and including a tapered face plate proximate to the wafer support, an edge of the tapered face plate exhibiting a reduced thickness relative to a thickness of a center of the face plate to create a taper angle, such that material deposited on a wafer in contact with the wafer support exhibits a uniform center-to-edge thickness.

13. The apparatus of claim 12 wherein the taper angle is between about 0.5° and 5°.

14. The apparatus of claim 12 wherein the tapered face plate comprises:
an inlet portion configured to receive a flow of a processing gas, the inlet portion comprising an aperture having a width;
an outlet portion configured to convey the processing gas flow to a semiconductor wafer, the outlet portion comprising an elongated slot in fluid communication with the aperture.

15. The apparatus of claim 14, wherein the elongated slot has a length at least one-half a thickness of the face plate.

1 16. The apparatus of claim 14 wherein the elongated slot is circular and
2 continuous.

1 17. The apparatus of claim 14 wherein a width of the elongated slot is
2 greater than the width of the aperture.

1 18. The apparatus of claim 17 wherein the width of the elongated slot is at
2 least 2.25x larger than the width of the aperture.

1 19. A method of distributing gas during a semiconductor fabrication
2 process comprising:
3 flowing a gas from a gas source to an inlet portion of a gas distribution face
4 plate featuring a hole having a width; and
5 flowing the gas from the hole to a surface of a semiconductor wafer through
6 an elongated slot of an outlet portion of a gas distribution face plate.

1 20. The method of claim 19 wherein the gas is flowed through an
2 elongated slot having a length at least one-half a thickness of the gas distribution face plate.

1 21. The method of claim 19 wherein at least one of a carrier gas and a
2 process gas are flowed through the face plate.

1 22. The method of claim 19 wherein the gas is flowed during a chemical
2 vapor deposition (CVD) process.

1 23. The method of claim 19 wherein the gas is flowed during a process of
2 high temperature deposition of undoped silicate glass, such that a spacing between the face
3 plate and the wafer is 300 mils or less.

1 24. The method of claim 19 wherein the flowed gas is selected from at
2 least one of the group consisting of tetraethylorthosilane (TEOS), triethylphosphate (TEPO),
3 triethylborate (TEB), ozone (O₃), oxygen, helium, and nitrogen (N₂).

1 25. The method of claim 19 wherein the flowed gas results in deposition of
2 a material selected from the group consisting of borosilicate glass (BSG), phosphosilicate
3 glass (PSG), and borophosphosilicate glass (BPSG).

1 26. The method of claim 19 wherein the gas is flowed from the gas
2 distribution faceplate having an edge portion recessed relative to a center portion to create a
3 face plate taper angle of between about 0.5° and 5°.

1 27. The method of claim 19 wherein the gas is flowed during a dry etching
2 process.

1 28. An apparatus for forming a material on a semiconductor wafer, the
2 apparatus comprising:
3 a processing chamber defined by walls;
4 a wafer support positioned within the processing chamber and configured to
5 receive a semiconductor wafer;
6 a processing gas supply; and
7 a gas distribution showerhead overlying the wafer support and including a
8 tapered face plate proximate to the wafer support, the tapered face plate comprising,
9 an inlet portion configured to receive a flow of a processing
10 gas, the inlet portion comprising an aperture having a width, and
11 an outlet portion configured to convey the processing gas flow
12 to a semiconductor wafer, the outlet portion comprising an elongated slot in
13 fluid communication with the aperture,
14 wherein an edge of the tapered face plate exhibits a reduced thickness relative
15 to a thickness of a center of the face plate to create a taper angle, such that material deposited
16 on a wafer in contact with the wafer support exhibits a uniform center-to-edge thickness.

1 29. The apparatus of claim 28 wherein the taper angle is between about
2 0.5° and 5°.